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(71) Applicant(s)
Micromill Electronics Ltd
The Old Mill, Queen Street, EMSWORTH, Hampshire, PO10 7BT, United Kingdom

(72) Inventor(s)
Jeffery Allen

(74) Agent and/or Address for Service
D Young & Co
21 New Fetter Lane, LONDON, EC4A 1DA, United Kingdom

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UK CL (Edition N) **H4D DAA DAB DBA DBB DBF DBG DBHA DBHX DBKA DBKB DBKC DBKD DBKE DBKX DBR DFAA DFAB DFAX DFBA DFBB DFBC DFBX DFC DFD DFX DMXX DPBA DPBC DPBX DPDA DPDD DPDK DPDN DPDR DPDX DPX**
INT CL^6 **G01B , G01S , G08C**

(54) Position or orientation determination

(57) In order to determine the position or orientation of a second device 2 a first device 1 is used. The first device 1 incorporates a GPS position sensor 3 and/or magnetometer orientation sensor 4. The first device 1 is moved to close by the second device 2 and may be mounted or held on it (for orientation determination). The first device then transmits position and/or location data to a memory in the second device, after which it is disabled and taken away. Subsequently the second device transmits its stored position along with other data.

Application is to determining the orientation of a direction-finding antenna after it is set up, determining the position of security sensors after they are installed, or determining the correct position of equipment incorporating an audit tag.

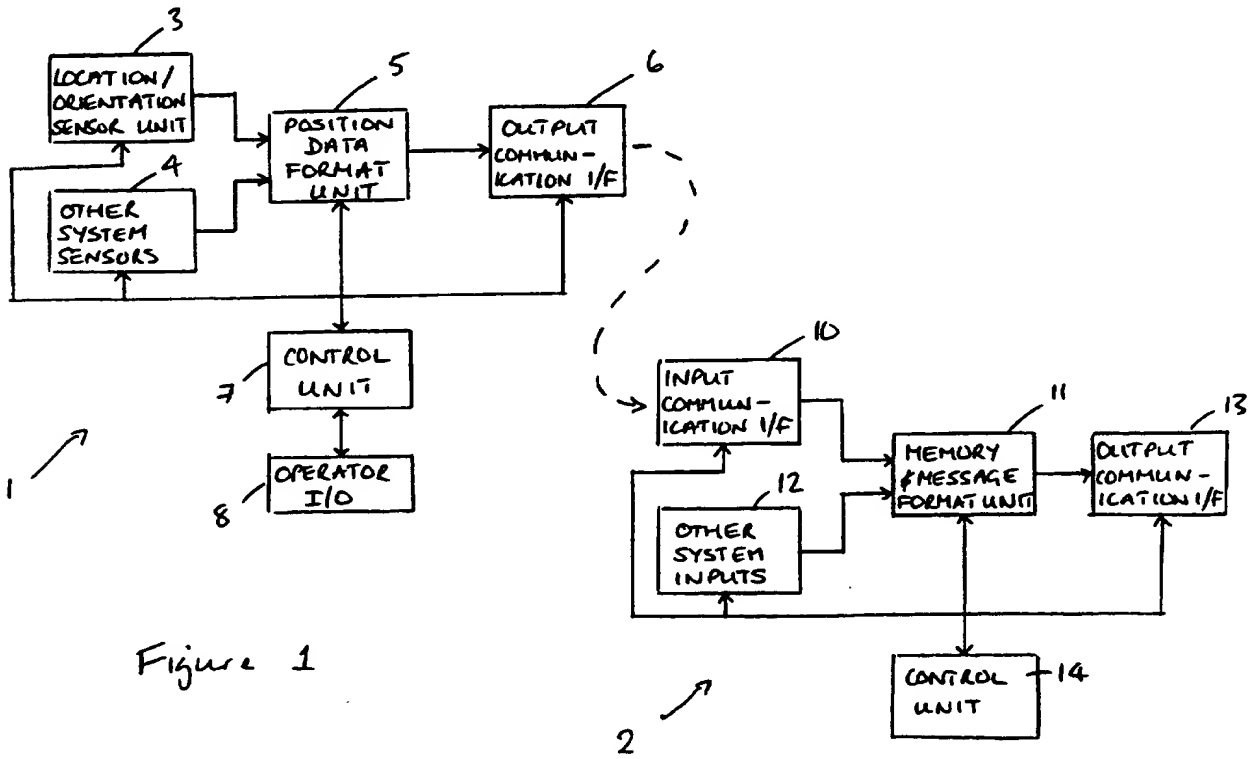

Figure 1

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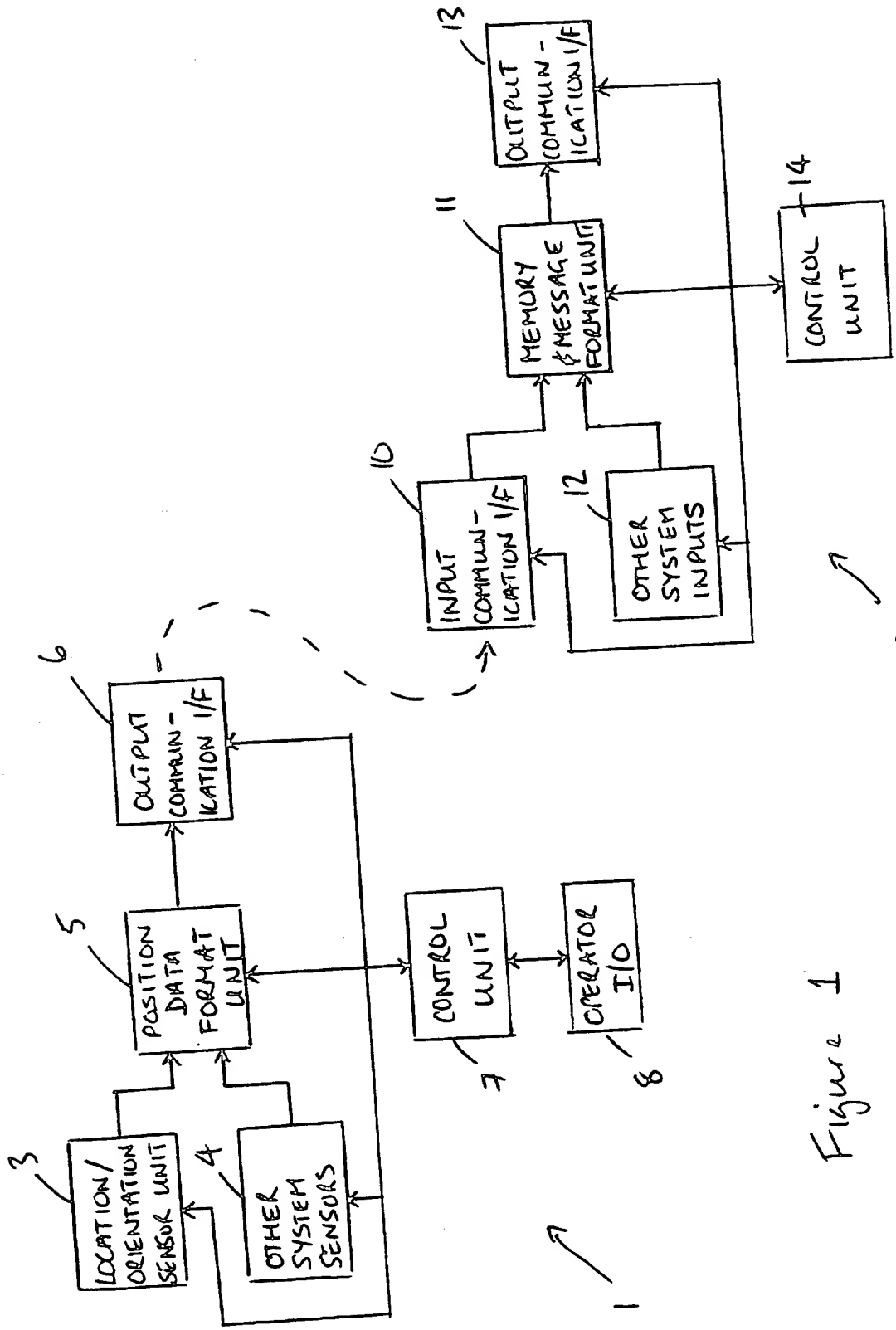

Figure 1

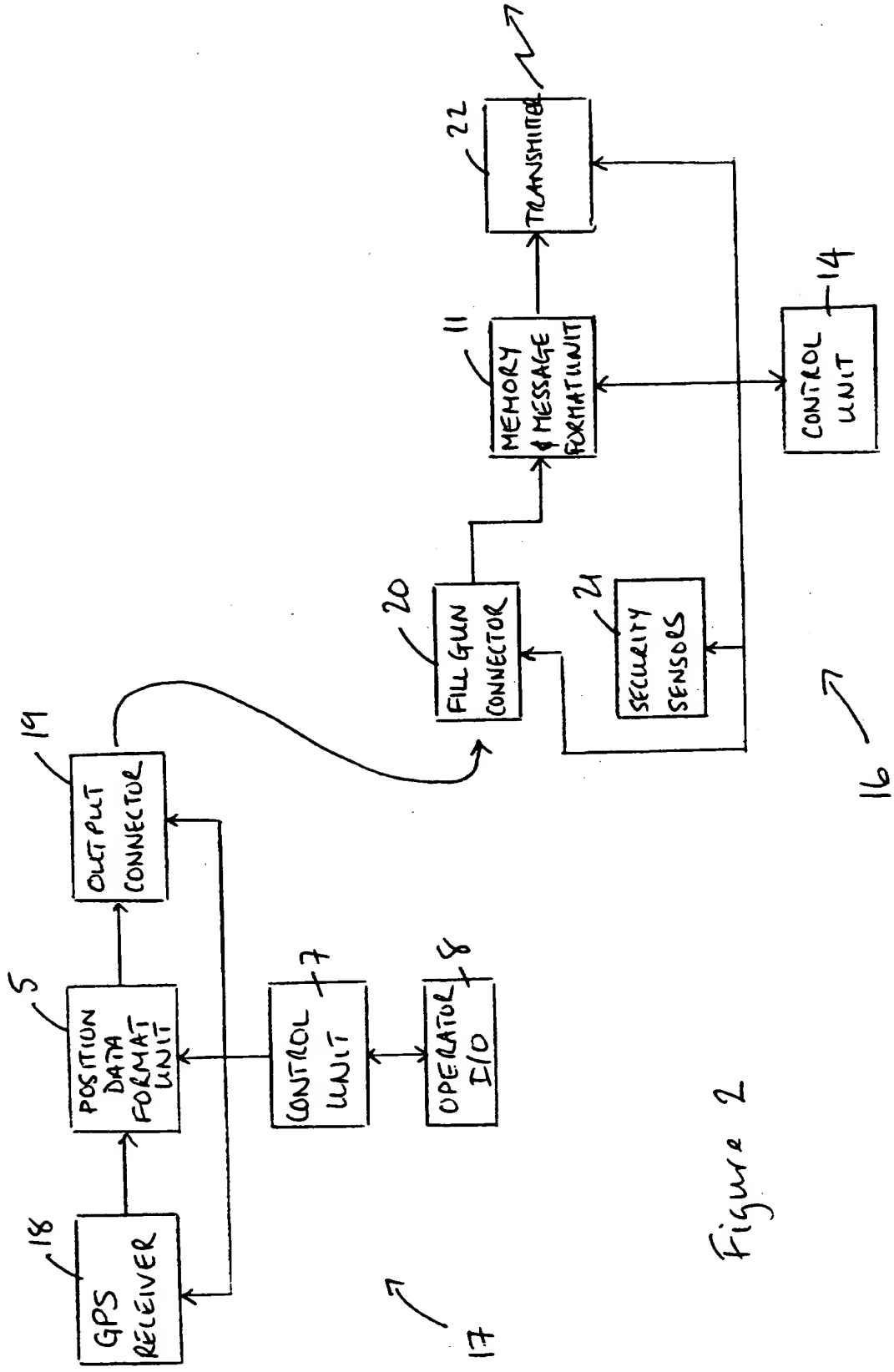

Figure 2

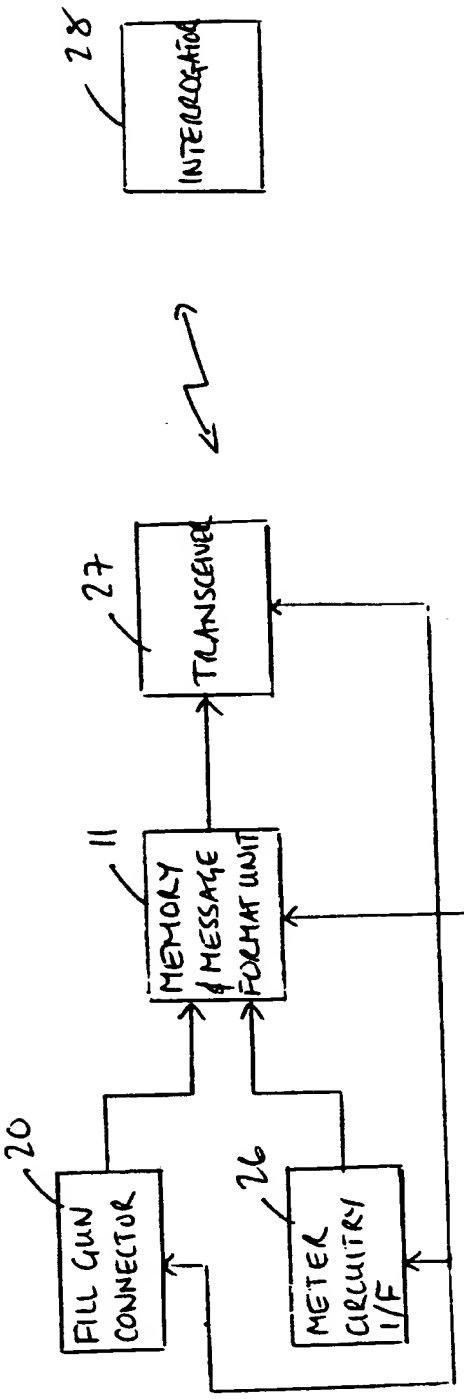

Figure 3

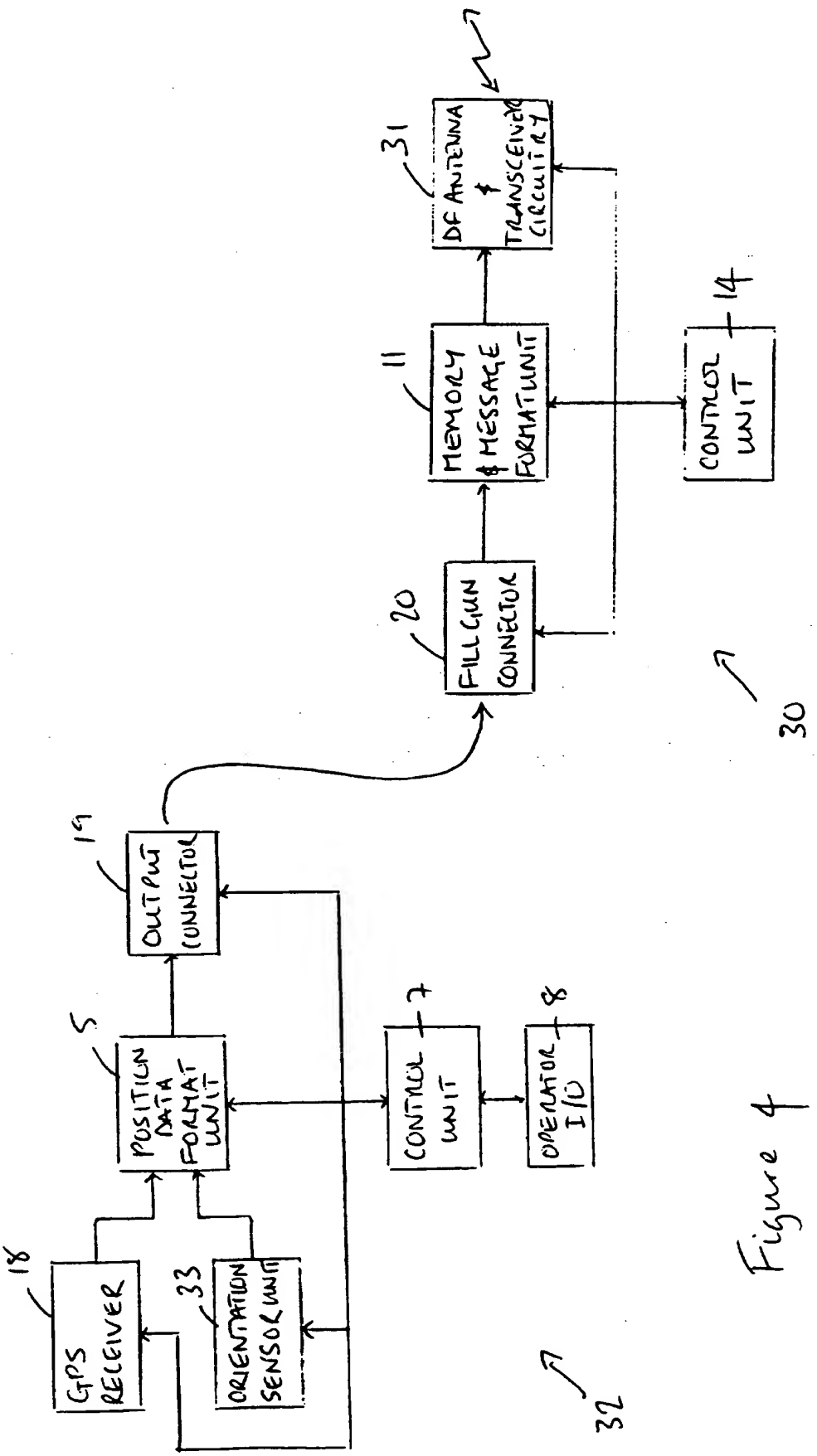

Figure 4

POSITION INDICATION SYSTEMS

This invention relates generally to position indication systems.

In many applications it is necessary or desirable for the position of a device to be known. "Position" is used herein in its broadest sense and is intended to include location (geographical location, situation, altitude etc.) and arrangement (disposition, attitude, orientation etc.) as the context requires. As an example of an application where such position information is required, it is necessary for the orientation and/or geographical location of antennas forming part of a direction finding (DF) system to be known. As a further example, there is a requirement for the geographical location of security detectors deployed as part of remote sensor systems, such as ground sensor systems, to be known with high accuracy. In such systems, position sensing equipment, such as GPS (Global Positioning System) receivers have therefore been incorporated in the security detectors. The present invention finds application not only in the fields just mentioned but in a number of other fields as will be described hereinafter.

According to one aspect of the present invention there is provided position indication apparatus comprising first and second devices, wherein the first device is arranged for deriving position data which is indicative of the position of the second device when the first device is sited at the location of the second device, and for transmitting the position data to the second device; wherein the second device has a memory for storing the position data and means for transmitting a message dependent on the position data; and wherein the first device is adapted to be removed from the location of the second device after transmitting the position data thereto.

According to this aspect of the invention, therefore, a first device is provided for deriving position data, and the position data derived by the first device can be transmitted to and stored in the second device whereupon the first device can be removed. In operation, the second device is situated at a desired location, and the first device is operated at the location of the s cond d vice (i.e. with the first device connect d to, or situated in the vicinity of, the second device) to derive the position data. The first device may in fact

determin its own position but when cited at th location of th sec nd device the position data so derived will of course be indicative of the position of the second device. After the position data has been transmitted to and stored in the memory of the second device, the first device can be taken away and used for installing other similar devices. The position data stored in the second device, which is indicativ of the position thereof, can be used by the second device to formulate a message which is transmitted as required depending on the particular application.

With this aspect of the invention, therefore, the same position sensing equipment (provided by the first device) can be used for a number of second devices for which position information is required. Since position sensing equipment need not be incorporated in each individual second device, each second device can be smaller, simpler in construction, lower in cost, and consume less power than devices where the position sensing functions are integral.

In accordance with a second aspect of the invention ther is provided position indication apparatus comprising: means for deriving position data which is indicative of the position of the apparatus; a memory for storing the position data; means for transmitting a message dependent on the position data; and means for disabling the said means for deriving position data after storage of the position data in the memory. With this aspect of the invention, although the means for deriving position data may be an integral part of the apparatus, m ans are provided to disable the position sensing equipment after use so as to reduce power consumption of the apparatus.

While the following description will focus on embodiments of the first aspect of the invention, it is to be understood that corresponding features may be provided, where appropriate, in embodiments of the second aspect of the invention, the first and second devices of embodiments of the first aspect being considered as integral features in embodiments of the second aspect, and the first device being disabled after use, rather than removed, in embodiments of the second aspect.

In embodiments f the inv ntion, the second devic comprises sensor means for detecting an alarm condition and is arranged to transmit an alarm message comprising the position data in response to

detection of an alarm condition. In particular, the second device maybe a security sensor for use as part of a remote sensor system, such as a ground sensor system, as previously mentioned. Here, however, the security sensors are substantially simplified as there is no need for each sensor to incorporate position sensing equipment. The first device, which may comprise a GPS receiver, for example, or any other suitable position sensing equipment, can be used for installing all the sensors, the position data being transferred to each sensor at the time of deployment. Each sensor then uses the pre-stored position data to formulate an alarm message if triggered, the alarm message being received at a remote control station where the position of the triggered sensor can be displayed, for example on a map of the area. The sensors in this embodiment can therefore be simpler in construction, more cost efficient, and have lower power consumption than systems in which the sensors incorporate integral position sensing equipment.

As noted above, the position data may indicate geographical location, e.g. a grid reference, but may of course indicate location in any predefined coordinate system, for example location relative to some predetermined fixed point. As previously explained, however, the position data is not limited to an indication of location, but may indicate other aspects of position, for example orientation (heading and/or attitude, tilt angle etc.). A particular example of where orientation information is useful is the installation of antennas, for example as part of a direction finding system. Here, the first device may include location sensing means to determine the geographical location to allow for situations where the required location of the antenna is not predetermined, and also orientation sensing means for deriving position data indicative of the antenna orientation. The orientation sensing means can be of any suitable known form, including for example a magnetometer device. The first device can be positioned at a fixed orientation relative to the direction faced by the antenna, either manually, eg. with the aid of alignment features or markers on the device, or by connecting the first device to th second device by connection m ans which defines the rel tive orientation of the connected d vices. The orientation sensed by the first device then indicates the orientation of the antenna. In this application, th

locati n and/or orientation information in the position data stored in the memory can be used to derive a message signal which can be transmitted by the antenna to a remote monitoring station.

The invention can also be applied in systems other than those just described. In a general application, a number of units of equipment (second devices) may be deployed remotely from a control station. The position of each device is stored in the device at the time of deployment by means of the first device as previously described. The position data (e.g. location and/or orientation) may then be relayed automatically to the control station, together with any other data, for example device identity data, and may then be used for further recording or processing at the control station, e.g. to position data automatically on a display of a map or plan.

Another particular application is in audit tagging systems for equipment auditing. In this application, the second device may be arranged for connection to an object to be audited at a later time (e.g. a valuable item, metering equipment, safety equipment, building service equipment etc.). A number of second devices may be provided to tag, respective objects to be audited. The position data for each second device, or tag, is derived by the first device and transmitted to the second device at the time of deployment. Audits of such tagged objects may then be carried out at future times by means of an interrogator, for example at a remote auditing station. To perform an audit, the interrogator transmits an interrogation signal. The tags include means for receiving the interrogation signal and are arranged such that, on receipt of the interrogation signal, a message comprising the position data is transmitted back to the audit station. In addition to the position data derived by the first device, the tags may be arranged to store object data relating to the respective objects, and the message transmitted by the tags may comprise the position data and the object data. In the case of auditing metering equipment, for example, the object data may comprise data such as meter identity, meter reading and current operational status.

As an alternative to transmitting th message via a radio link to a remote auditing station, the interrogator may be a portable unit which can b operated in close proximity to the tagged object, for exampl by connection to the tag. Either way, such embodiments of the

invention provid highly convenient asset checking/maintenance systems.

As a further example, the invention can be applied to way-point markers and survey reference systems. Here, the second device comprises a marker, and a number of such markers can be deployed at different locations. The first device is used to derive and transmit position data to each of the markers as previously described. The markers can be arranged to transmit messages comprising the position data, either periodically or in response to an interrogation signal. The messages can be received by an interrogation/reader device and used as an aid to navigation (e.g. to provide a position fix) or as a reference for survey purposes.

It will be appreciated that, where features are described herein with reference to apparatus embodying the invention, corresponding features maybe provided in accordance with a method of the invention and vice versa.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a generalised block diagram of first and second devices of apparatus embodying the invention;

Figure 2 is a schematic block diagram of an embodiment for use in a ground sensor system;

Figure 3 is a schematic block diagram of an audit tag in another embodiment of the invention; and

Figure 4 is a schematic block diagram of DF antenna deployment apparatus in another embodiment of the invention.

Referring to the generalised block diagram of Figure 1, the apparatus comprises a first device, indicated generally at 1, and a second device, indicated generally at 2. The first device 1 includes a location/orientation sensor unit 3 which may incorporate a GPS receiver, or any other suitable location sensing equipment, for detecting the location of the device 1. In addition, or alternatively, the unit 3 may include orientation sensing equipment of known form for detecting the orientation of the device 1. The device 1 may further include other system sensors, indicat d generally at 4, for sensing other aspects of the position of the device 1, such as altitude for example. Outputs of the units 3, 4 are connected to a position data format unit 5 which generates position data comprising the information

output by th sensor units 3, 4. Th output of the position data format unit 5 is connected to an output communication interface 6 for transmitting position data to the second device 2. A control unit 7 controls operation of the sensor units 3, 4, the position data format unit 5 and the output communication interface 6. The control unit 7 is connected to an operator input/output section 8 by means of which an operator can activate the device 1 and which may provide a display to indicate the operational status of the device for example.

The second device 2 comprises an input communications interfac 10 for receiving position data from the first device 1. The interfac 10 is connected to a memory and message format unit 11 for storing position data received by the device 2 and generating messages in dependence on the position data for transmission by the device 2. Other system inputs, indicated generally at 12, the form of which depends upon the particular application of the device, may also be connected to the message format unit 11 for use in generating the message data to be transmitted. Messages output by the message format unit 11 are supplied to an output communications interface 13 for transmitting the messages to a control station or interrogator/reader device as will be described hereinafter. The communications interfac s 10, 13, system inputs 12, and message format unit 11 operate under control of a control unit 14 of the device 2.

The general operation of the system is as follows. The devic 2 is deployed at a desired location, and the device 1 is sited at th location of the device 2, either by simply placing the device 1 in the vicinity of the device 2 or by directly connecting the device 1 to the device 2 by appropriate connecting means of the communications interfaces 6, 10. With the device 1 appropriately positioned relative to the device 2, the operator activates the device 1 by means of th I/O section 8. The control unit 7 then activates the sensor unit 3, and the sensor unit 4 if provided, to measure the position/orientation/altitude etc. as appropriate of the device. The control unit 7 then controls the position data format unit 5 to formulate th position data from the inputs from the sensor units 3, 4 and to output th position data to the interfac 6. The interface 6 is in turn nabled by the control unit 7 to transmit th position data to the device 2. As noted abov , the first d vice may b directly

connected to th s cond device for transmitting the position data, or transmission may be effected by wireless communication such as optical coupling, coupled magnetic loop etc.

On receipt of the position data by the input communications interface 10 of the device 2, the control unit 14 of the device controls storage of the data in the memory and message format unit 11. When a message is to be transmitted by the device 2, the control unit 14 activates the unit 11 to formulate the message in dependence upon the position data stored in the memory and data received from the system inputs 12 where provided. The message is output to the output communications interface 13 which is in turn activated by the control unit 14 to transmit the message.

It will be appreciated that the control units 7, 14 may incorporate power supply means such as a battery pack for supplying power to the various components of the devices. Also, although in the preferred embodiments described here the first device is removable from the location of the second device after storage of the position data, in other embodiments the communication interfaces 6, 10 may be omitted so that the position data format unit 5 is connected directly to the message format unit 11 to form apparatus in which the devices are permanently connected. In this case, the control means includes means for disabling at least the position sensing units by cutting the power to these units after storage of the position data to reduce power consumption by the apparatus.

Figure 2 is a schematic block diagram of particular embodiment of the invention forming part of a ground sensor system. Here, the generalised device 2 shown in Figure 1 is in the form of a security detector indicated generally at 16, and the generalised device 1 of Figure 1 is in the form of a fill gun indicated generally at 17. The fill gun 17 comprises a GPS receiver 18 of known type, the position data format unit 5, control unit 7 and I/O section 8 as previously described, and an output connector 19 for directly connecting the fill gun to the security detector 16. The detector 16 comprises a fill gun input connector 20 for connecti n to the output connector 19 of the fill gun, a s curity sensor unit 21, a m mory and message format unit 11 and control unit 14 as previously described, and a radio transmitter 22 forming the output communications interface. The s curity sensor

unit 21 may include one or more sensors of known type, such as movement sensors, heat sensors and sensors to detect tampering with the devic .

In operation, a number of security detectors 16 are deployed around an area to be secured. As each detector 16 is located, the fill gun 17 is connected to the detector 16 by means of the connectors 19, 20, and the operator then activates the fill gun by means of the I/O section 8. The control unit 7 of the fill gun then activates th GPS receiver 18 to determine the geographical position of the devic in known manner. The GPS receiver 18 of course detects its own position but this is effectively the position of the security detector 16 sinc the two devices are connected. The control unit 7 of the fill gun 17 controls the position data format unit 5 to formulate position data from the position information received from the GPS receiver 18. The position data is supplied to the output connector unit 19 which is enabled by the control unit 7 to transmit the position data to the detector 16. On receipt of the position data by the fill gun input connector 20, the control unit 14 of the detector 16 controls the message format unit 11 to write the position data to its internal memory.

Once the position data has been successfully transferred to the detector 16, as may be indicated on the I/O section 8 of the fill gun, the fill gun 17 is disconnected from the detector 16 and can be us d for installing the next detector in the same way. After installation, each detector 16 remains dormant until the security sensor unit 21 detects a security breach. The alarm condition is then indicated to the control unit 14 which activates the message format unit 11 to output to the transmitter 22 a message comprising the position data. The control unit 14 activates the transmitter 22 to transmit th message to a remote control station. At the control station, the geographical location of the activated detector, as indicated by the position data, can be displayed on a map or plan of the area, or listed on a display or printout for example, to indicate the site of th security breach.

In som ground sensor systems embodying th invention, the m ssag transmitt d by the security det ctor 16 may include data in addition to th pr -stored position data. For example, th security sensor unit 21 may provide an input to th message format unit 11 for

sensor status data. This data may indicate which particular sensor has been triggered where a number of sensors are provided in the unit 21. This alarm status data may be included in the message to indicate the particular source of the alarm condition at the control station. Further, the control unit 14 may be arranged to detect failure of any part of the detector circuitry and initiate transmission of a message indicating this fact together with the position data. Also, to facilitate set-up of the system, the control unit may be arranged to effect transmission of a message automatically when the position data is first stored in the memory to indicate the location of the sensor at the control station. Of course, if the transmitter 22 is replaced by a transceiver unit, the control unit could effect message transmission on receipt of an interrogation signal from the control station.

Figure 3 illustrates a second device of apparatus embodying the invention forming part of an audit tagging system. Here, the generalised second device illustrated in Figure 1 is in the form of an audit tag, indicated generally at 25. The audit tag 25 can be constructed in any convenient manner for attachment (tagging) to a static object or equipment to be audited at a later time, such as a valuable item, safety equipment, building services equipment or metering equipment for example. The audit tag 25 could of course be incorporated as a permanent part of such equipment where appropriate.

The audit tag 25 in this embodiment can be used with a fill gun 17 as already described with reference to Figure 2. The tag 25 comprises a fill gun input connector 20, and a control unit 14 and memory and message format unit 11 as previously described. In this embodiment, the tag 25 is designed for use with metering equipment, such as an electricity meter, and includes an interface 26 for connecting the tag to the meter circuitry for receiving status and meter reading information therefrom. An output of the meter circuitry interface 26 is connected to the message format unit 11. An output of the message format unit 11 is connected to a radio transceiver unit 27 which can transmit messages to, and receive messages from, an interrogator device indicated schematically at 28.

In operation, once the tag 25 has been attached to the meter (or the meter with integral tag has been sited at the desired location), the output connector 19 of the fill gun 17 is connect d to the fill gun

input connector 20 of the tag 25. An operator input via the fill gun I/O section 8 then triggers the control unit 7 to activate the GPS receiver 18 and the geographical position data measured thereby is supplied to the position data format unit 5 as previously described. In some embodiments, the I/O section 8 of the fill gun 17 may include a key pad to enable the operator to key in data relating to the meter itself, for example an ID code. Such data can then be supplied by the control unit 7 to the position data format unit 5 for incorporation in the position data formulated thereby. Either way, the position data is output by the fill gun 17 to the tag 25. The position data is stored in the internal memory of the message format unit 11 under control of the control unit 14. The fill gun 17 can then be removed and used to install similar tags on other meters.

Audits of the tagged items can be carried out when desired using the interrogator 28. In this embodiment, the interrogator 28 is assumed to be located at a remote auditing station. In operation, the interrogator 28 transmit an interrogation signal which is received by the transceiver 27 of the audit tag 25. Receipt of the interrogation signal is indicated to the control unit 14 which then activates the message format unit 11. This unit formulates a message comprising the position data stored in its internal memory and the current meter reading received from the meter circuitry interface 26. The message is output to the transceiver 27 which is then activated by the control unit 14 to transmit the reply message to the interrogator 28. The current location, status and readings of all tagged meters can therefore be determined at the auditing station.

In an alternative embodiment of the system just described, the interrogator 28 may be a portable device, operable in close proximity to a tag 25, and may even be directly connectable to an output connector of the tag replacing the transceiver 27, to interrogate the tag and read the reply message when physically connected to the tag. In addition, it will be appreciated that communication between the tag and interrogator could be effected by wireless communication such as ultrasonic, infra-red, optical or magnetic coupling if desired.

A further embodiment of the invention applied to a DF antenna system will now be described with reference to Figure 4. This system is particularly advantageous where DF antenna systems need to be

installed quickly since the position of the antennas can be detected and stored in the associated circuitry at the time of installation. In Figure 4, the generalised second device illustrated in Figure 1 is in the form of a DF receiving antenna device indicated generally at 30. The device 30 comprises a DF antenna and associated transceiver circuitry 31 which also provides the output communication interface of the device. The device 30 also includes a fill gun input connector 20, memory and message format unit 11, and control unit 14 as previously described. The fill gun for use with the DF antenna device 30 is indicated generally at 32. The fill gun 32 comprises a GPS receiver 18, position data format unit 5, output connector 19 and control unit 7 with I/O section 8 as previously described. The fill gun 32 also includes an orientation sensor unit 33 for detecting the orientation of the device in known manner. In operation, the DF antenna device 30 is installed at the desired location, and the fill gun 32 is connected to the fill gun input connector 20 of the device. In this embodiment, the connectors 19, 20 are designed so that, when engaged, the fill gun 32 is orientated with a predetermined orientation relative to the orientation of the DF antenna 31. The fill gun 32 is then activated via the I/O section 8 causing the control section 7 to activate the GPS receiver 18 and orientation sensor 33. The geographical position of the fill gun, and hence the antenna 31, is output by the GPS receiver 18 to the position data format unit 5. Equally, the orientation of the fill gun 32, which thus indicates the orientation of the DF antenna 31, is output by the orientation sensor 33 to the position data format unit 5. The control unit 7 controls the format unit 5 to formulate the position data from the input data and the position data is then transmitted to the antenna device 30 via the output connector 19. On receipt of the position data via the fill gun input connector 20, the control unit 40 effects storage of the position data in the internal memory of the message format unit 11. The fill gun 32 is then disconnected and can be used for installation of other DF antennas in the system.

In operation, the DF antenna 31 receives a signal from an object being tracked, and data derived from the received signal, e.g. the phase relative to a reference signal, is supplied to the control unit 14. The control unit 14 activates the message format unit 11 to

formulate a message d rived from the input signal data and th position data stored in the internal memory of the unit. The message is then output to the antenna and transceiver circuitry 31 and transmitted on to a remote control station. The transmitted message is thus deriv d from the received signal and the position of the antenna itself. The antenna device may be arranged to transmit messages to the control station periodically, eg. every few seconds, these messages being used together with messages received from other DF antenna devices 30 in the system to determine the position of the object being tracked in the control station.

A device similar to the DF antenna device 30 of Figure 4 can be used as a marker in a way-point marker system. Here, however, the DF antenna/receiver circuitry 31 of Figure 4 can be replaced by a simpler transceiver unit which simply indicates detection of an interrogation signal to the control unit 14. A number of the markers may be deployed as route markers for example, each being programmed with position data from a fill gun as previously described at the time of deployment. An interrogation unit in a vehicle for example may provide a display showing a map of the area through which the vehicle is travelling. To follow the required route, the interrogation unit transmits an interrogation signal which is picked up the transceiver circuitry of way-point markers in the vicinity. Each way point marker then transmits a message comprising the pre-stored position data, and the messages are received by the interrogator which may then indicate the positions of the markers on the displayed map. Alternatively, the received data may be used to provide correction in a navigational system in the vehicle. For example, the system may make compass and distance measurements based on signals received from the markers to detect and update the position of the vehicle. Such markers can also be used in other systems, for example as survey reference markers in geographical surveying systems.

It will of course be appreciated that various modifications and variations may be made to the specific embodiments described above without departing from th scope of the invention. Further, various other applications for embodiments of th invention may be envisaged.

CLAIMS

1. Position indication apparatus comprising first and second devices, wherein the first device is arranged for deriving position data which is indicative of the position of the second device when the first device is sited at the location of the second device, and for transmitting the position data to the second device; wherein the second device has a memory for storing the position data and means for transmitting a message dependent on the position data; and wherein the first device is adapted to be removed from the location of the second device after transmitting the position data thereto.

2. Apparatus as claimed in claim 1, wherein said position data indicates location in a predefined coordinate system.

3. Apparatus as claimed in claim 1 or claim 2, wherein said position data indicates geographical location.

4. Apparatus as claimed in any preceding claim, wherein said position data indicates the orientation of the second device.

5. Apparatus as claimed in any preceding claim, including connection means for releasably connecting the first and second devices for siting the first device relative to the second device and for transmission of the position data from the first device to the second device.

6. Apparatus as claimed in any preceding claim, wherein the means for transmitting said message comprises a transmitter for wireless communication with a remote receiving station.

7. Apparatus as claimed in any preceding claim, wherein the second device comprises sensor means for detecting an alarm condition, the second device being arranged to transmit an alarm message comprising said position data in response to d tection of said alarm condition.

8. Apparatus as claimed in claim 7 wherein the s nsor means comprises a security sensor.

9. Apparatus as claimed in any one of claims 1 to 6, wherein the second device comprises an antenna of a direction finding system.

10. Apparatus as claimed in any one of claims 1 to 6 wherein the second device is arranged to transmit said message in respons to receipt of an interrogation signal.

11. An audit tagging system comprising apparatus as claimed in any one of claims 1 to 6, wherein the second device is arranged for connection to an object to be audited and is arranged to transmit said message in response to receipt of an interrogation signal.

12. Apparatus as claimed in claim 11, wherein the second device is arranged to store object data relating to the object to be audited and wherein said message comprises the position data and said object data.

13. Apparatus as claimed in any one of claims 10 to 12, including an interrogator for transmitting said interrogation signal to the second device and receiving said message therefrom.

14. Apparatus substantially as hereinbefore described with reference to the accompanying drawings.

15. Position indication apparatus comprising: means for deriving position data which is indicative of the position of the apparatus; a memory for storing the position data; means for transmitting a message dependent on the position data; and means for disabling the said m ans for deriving position data after storage of the position data in the memory.

16. A method for installing the second device of position indication apparatus as claimed in one of claims 1 to 14, the method comprising:

placing the second device at a desired location;

siting the first device at the location of the second device;

activating the first device to derive said position data and to transmit the position data to the second device for storage in the memory thereof; and

removing the first device from the location of the second device.

17. A method for installing the second device of position indication apparatus as claimed in any one of claims 1 to 14, which method is substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

Application No: GB 9503296.7 **Examiner:** E P Plummer
Claims searched: 1 to 14, 16 & 17 **Date of search:** 7 April 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): H4D(DAA,DAB,DMXX,DFAA,DFAB,DFAX,DFBA,DFBB,DFBC, DFBX,DFC,DFD,DFX,DPBA,DPDA,DPDD,DPDG,DPDK,DPDN, DPDR,DPDX,DPBC,DPBX,DPX,DBA,DBB,DBF,DBG,DBHA, DBHX,DBKA,DBKB,DBKC,DBKD,DBKE,DBKX,DBR)

Int Cl (Ed.6): G01S, G08C, G01B

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

The Patent Office

Application No: GB 9503296.7
Claims searched: 15

Examiner: E P Plummer
Date of search: 12 July 1995

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): H4D(DAB,DPBA,DPDA,DPDD,DPDG,DPDK,DPDN,DPDR,DPDX,DPBC,DPBX,DPX,DBA,DBB,DBF,DBG,DBHA,DBHX,DBKA,DBKB,DBKC,DBKD,DBKE,DBKX,DBR,DSX)

Int Cl (Ed.6): G01S

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2277844A	SPECTRONICS & WO94/27265A1	
A	GB2270405A	BARRON	
A	GB2025185A	SIEMENS	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

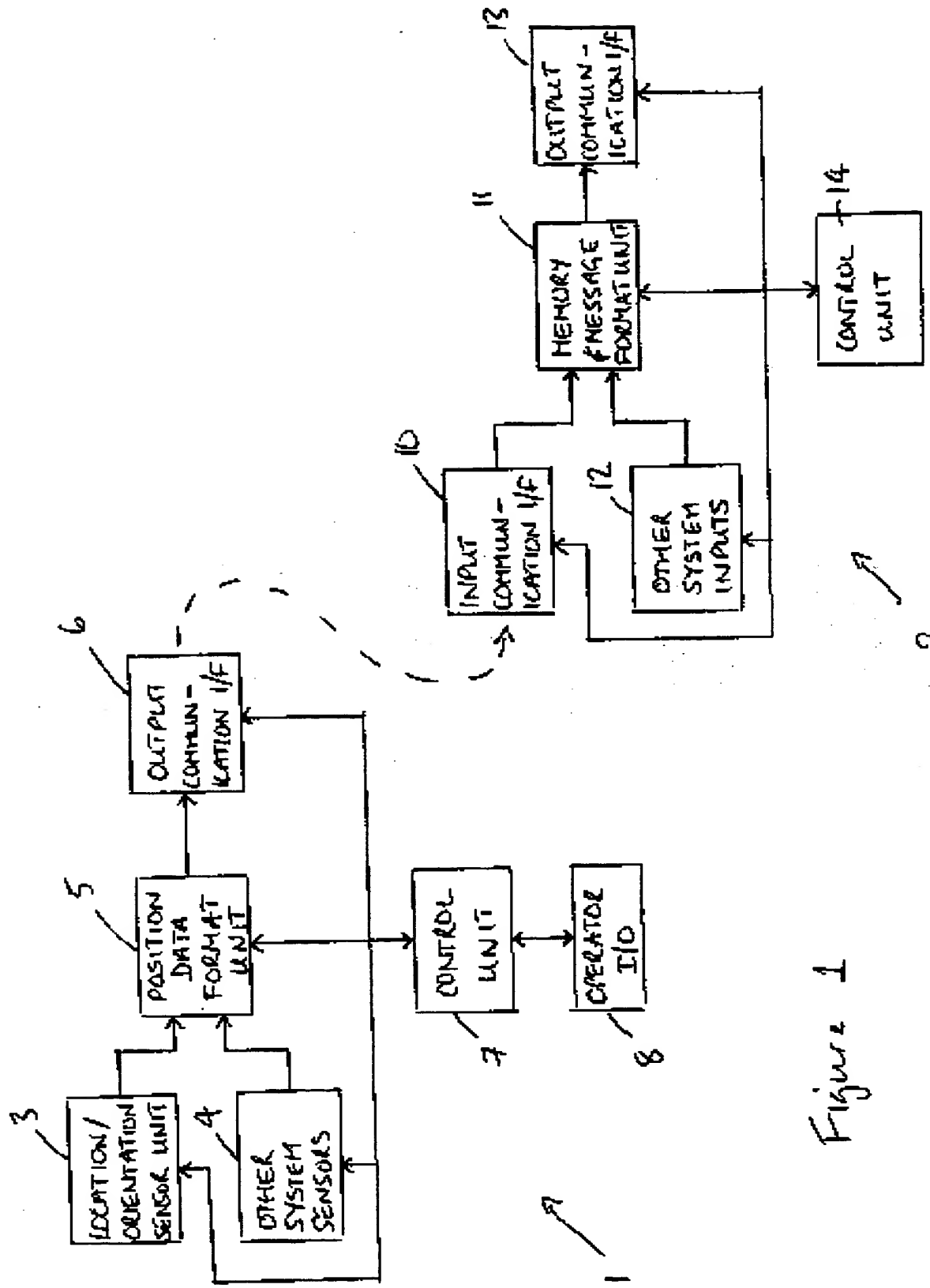

Figure 1

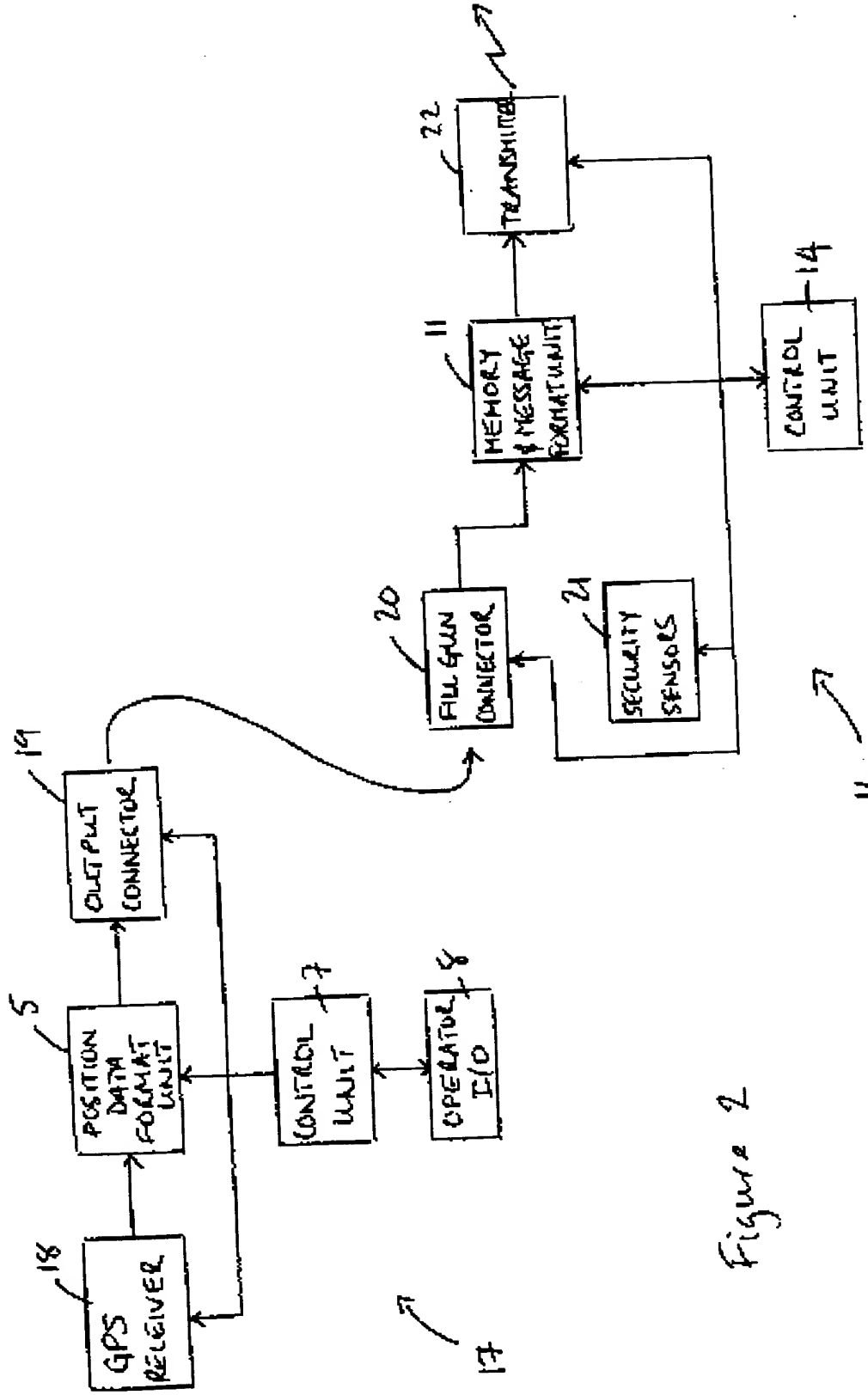
GPS RECEIVER
18
POSITION DATA FORMAT UNIT
5
OUTPUT CONNECTOR
19
CONTROL UNIT
7
OPERATOR I/O
8
17
FILL GUN CONNECTOR
20
SECURITY SENSORS
21
MEMORY & MESSAGE FORMATTING UNIT
11
TRANSMITTER
22
CONTROL UNIT
14
16

Figure 2

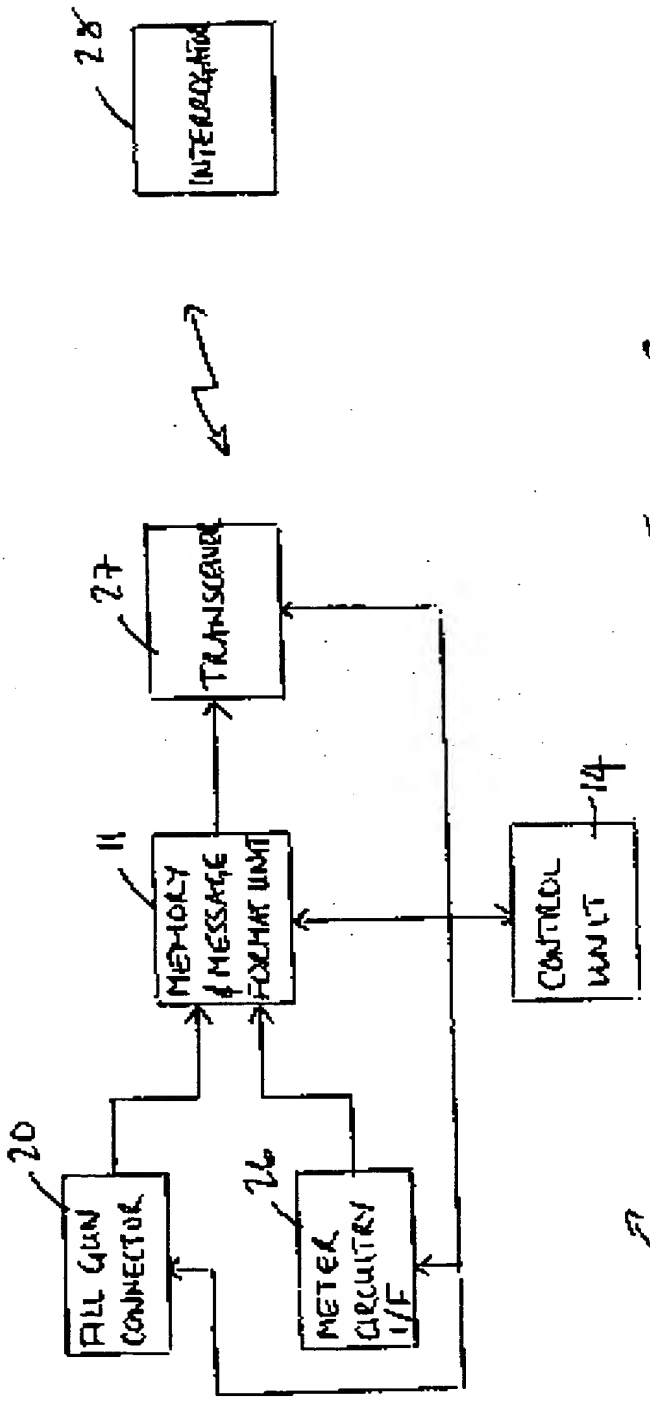

Figure 3

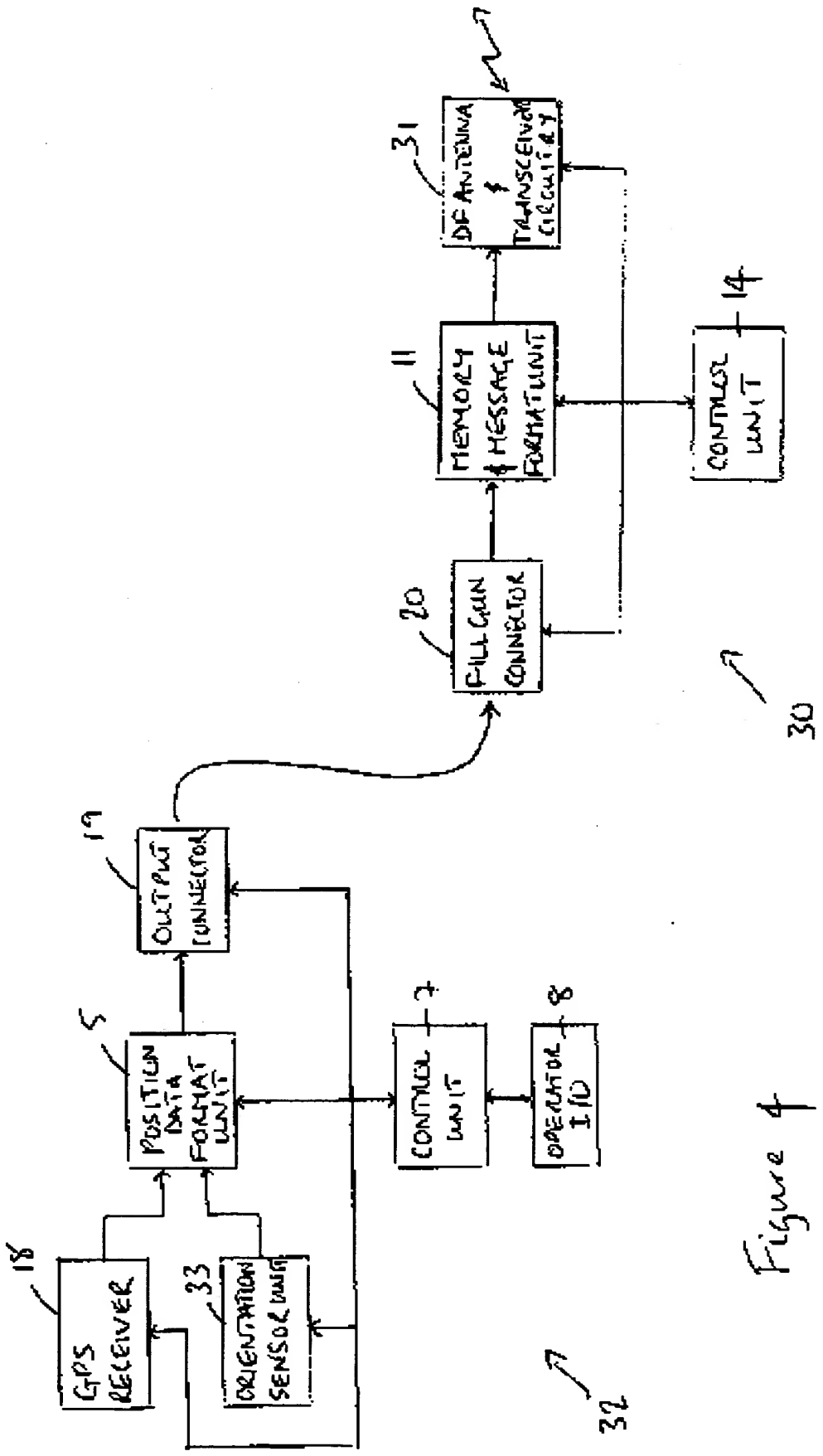

Figure 4